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AMERICAN METEOROLOGICAL JOURNAL.

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THE AMERICAN

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CURRENT NOTES.

METEOROLOGICAL CONFERENCE.—On invitation of the chief-signal officer, U. S. army, representatives of a number of the state weather services met in Washington on February 23 and 24, to consider the relation of state services to the signal service, matters of observation, display of local weather-signals, and related topics. The meeting was opened by General Hazen, chief signal officer. Prof. T. C. Mendenhall of the signal office was then chosen chairman, and Prof. W. M. Davis was appointed secretary. Four sessions were held in the lecture-room of the national museum, and the following action was taken:

The conference recommends that the volunteer observers of the state weather services should make their regular thermometric observations at 7 A. M., 2 and 9 P. M. When maximum and minimum thermometers are used, they should be read at the latest hour of observation in the day, preferably at 9 P. M. Observers of rainfall are advised to use the new form of rain-guage adopted by the signal service, or to follow this pattern as nearly as possible. The guage should, when practicable, be placed with the collecting-edge one foot above the ground, and should stand at least twice as far from adjacent objects, such as trees, buildings, fences, etc., as the height of these objects. The conference disapproves of placing rain-guages on the roofs of buildings.

The form of weather-signals received especial attention, and on the recommendation of the committee named below, the chief

signal officer was requested to make experiments to determine the relative visibility of signals of different kinds, especially with the pattern flags of the Ohio system, the solid colors of the Alabama system and a system of drums and cones that has been proposed. It was further requested that correspondence be instituted with the several state services now employing weather signals, with a view to learning what system would be the most satisfactory for general use.

Committees were appointed as follows: Messrs. Dunwoody, Mell and Upton, to prepare forms for records to be used by state services and volunteer observers; Messrs. Davis, Thomas, Mell, Dunwoody, and Woodruff, to report on a system of weather-signals for local display throughout the country; Messrs. Mendenhall, Fuertes, Dunwoody, Upton, and Payne, to consider plans for a permanent organization of the conference.

The attendance at the conference represented so many parts of the country, that its recommendations will doubtless have due weight in securing the desirable end of uniform methods of work in the state services now in operation, and in those yet to be formed. Among the members of the signal service, there were present Professor Mendenhall, Lieutenants Dunwoody, Woodruff, Finley, Walshe, and Day, Professors Ferrel, Abbe, Hazen, Russell, and Marvin, and Mr. McAdie. The state services were represented by Professer Thomas, of Ohio, Professor Payne of Minnesota, Professor Young of Nevada, Professor Mell of Alabama. Messrs. Henderson and Redding of the bureau of agriculture, Georgia, Professors Upton and Davis and Messrs. Rotch and Ellsworth of New England, and Professor Huston of Indiana. Professor Fuertes of Cornell university, and Mr. Gillingham of Virginia, volunteer observers of the signal service, were also present.

The conference adjourned, to meet again at the call of the committee on permanent organization.

At the meeting of the committee on permanent organization held after the adjournment of the conference, it was decided to organize under the name the Association of Local Weather Services, and to hold meetings annually in February. The object

of the association is to encourage and promote the mutual coöperation of the local weather services and the general weather service of the United States. Its membership is limited to the officers of local services or duly appointed delegates, together with representatives from the chief office.

W. M. D.

EARLY AMERICAN EXPLORATIONS.—In *Bulletin* No. 2, of 1885, of the American Geographical Society, Dr. E. N. Horsford gives the abstract of a detailed study of early maps of North America. The study shows great care and the use of unusual and rather inaccessible sources of information, and the conclusions are of interest. The site of Cabot's sandfall was Salem Neck, just north of Boston. The town of Norembegue, on the river of Norembegue of Allefonsce, and the fort of Norembegue and village of Agoncy of Thevet, were on the Charles river, between Riverside and Waltham, at the mouth of Stony brook, in latitude 42° 21′ north. If these conclusions are true, it follows that John Cabot discovered the continent of America before Columbus, for he was on the New England mainland in 1497, while Columbus reached South America (his first mainland) in 1498, and Vespucius a year later.

A CURIOUS RIVER—LAGOON GONE.—Lake Labish begins at a point twelve miles northeast of Salem, Oregon, and runs southwest about seven miles; thence nearly west for three miles to a point near the Willamette river. The lake varies in width from one-fourth to three-fourths of a mile. It seems to be formed by some large springs which issue near the middle of the lake, on a slight elevation, the waters flowing either way and emptying into Pudding river on the north, and the Willamette river on the southwest. A few years ago the county court authorized the cutting of a ditch twelve feet on the top, for a distance of two miles through the center of the lake, and as the result a large portion of the land has become sufficiently dry for cultivation. The land is the very choicest in the county Marion, and will no doubt soon be brought under a thorough state of cultivation.

NATIONAL PARKS.—Following the example of the United States in the case of the Yosemite and Yellowstone valleys, the province of New South Wales, in Australia, has set off the most interesting part of the public domain as a national park. The park is in the Illawara district, south of Sidney. It is small, containing about 2,200 acres, and has a frontage of seven miles on the Pacific ocean. It is selected with reference to its scenic interest, and with reference also to the perfections of its forests of palms, tree ferns, eucalypti, and other remarkable indigenous plants. It is traversed by Bola creek and Port Hacking river, and is accessible by railroad.

Senator Edmunds has introduced a bill recently into Congress to set aside a large territory in Montana as a forest reservation or hunting park. It is not easy from the newspaper reports to locate its outlines exactly, but the reservation stretches down the back bone of the Rocky Mountains a distance of about 75 miles from where they enter the United States, and is about 30 miles broad. It must contain 2,000 square miles or more, and is a picturesque, heavily wooded region, full of large and small game. It is not known as a mining region, and is little suitable for agriculture.

METEOROLOGY IN ITALY.—That Italy should take a prominent place in meteorological work is not remarkable. The peninsula has many geographical and physical features of remarkable interest, such as the sirocco, earthquakes, and volcanoes, and her comparatively isolated physical position makes many of the problems clearer and more sharply defined than elsewhere. She gave to the world two of the most important meteorological instruments, the barometer and thermometer. Apparently Italy was the first to establish meteorological observations, which was done in 1654. In continuation of this preëminence, Italy has now an annual meteorological congress, of which the first meeting occurred in 1880, and the last recently at Florence.

VELOCITY OF EARTH WAVES.—Some weeks ago Flood Rock, near New York, was blown up by a charge equivalent to about

one hundred and fifty tons of dynamite. It was an excellent opportunity to observe the velocity of propagation of the vibration through the earth's crust, and advantage was taken of it at various stations, generally by observations of tremors in a surface of mercury. The results are finally at hand, and I copy them, as below, from *Science:*

Stations.	Distance in Miles.	Interval of Transmission.	Velocity in Miles Per Second.
Willett's Point, Long Island.....	8.33	8 5 sec.	0.98
Pearsall's, " "	16.78	6.6	2.54
Bay Shore, " "	36.65	13.0	2.82
Patchogue, " "	48.52	15.4	3.15
Goat Island, R. I.....	144.89	58.8	2.46
Harvard Observatory.....	182.68	219.8	0.83
West Point, N. Y.....	42.34	13 6	3.11
		10.9	3.88
		10.9	3.88
Hamilton, N. Y	174.37	45.0	3.88
		45.2	3 86
Princeton, N. J.....	48.	51.	0.94

The resulting velocity has quite different values in different cases, as was to be expected in so heterogeneous a material as the earth's crust. It is noticeable, however, that while differing among themselves, the results in the same azimuth are fairly accordant. This is to be expected, and gives confidence in the results. The suggestion, however, of General Abbott that the velocity increases with the charge exploded, and therefore with the amplitude of the motion of each oscillating molecule deserves farther observations before acceptance. It is a well known principle in harmonic motions that the velocity of propagation is uniform for each medium, and is independent of amplitude. This is only true when the elasticity is perfect, but the law is substantially true for light and closely so for sound, and it would be true for water probably, were it not for some of the peculiarities of liquids as surface-tension. A variation of velocity of two or three times could not be expected in rock and drift, although a slight variation could be readily admitted.

Notes from the State Weather Services.—In the last

report for the year Professor Mell of the Alabama service says:

This report has been delayed in consequence of a desire to present full and complete data as to normals and extremes, for a period of over thirty years, and in computing and verifying means and totals for the year.

Thanks to the aid of our generous and efficient corps of observers, we are able to present facts and deductions of much interest and utility, whose value will undoubtedly be enhanced as time passes. The public are deeply indebted to those public spirited gentlemen who have, for so many years, through heat and cold, rain, sleet, snow and shine, good times and bad, kept such excellent records of the weather as have been placed at our disposal. It is doubtful whether the great value of such records is now fully appreciated by the masses of our people, but the future will make amend.

As pioneers in a work of great value Helm, Dawson, Boerner, and others of their co-laborers, have, by their labors, inscribed their names on a monument more honorable and enduring than if of brass or stone. As compilers it has been our aim to present, in a compact and convenient form, some transcriptions and deductions from their labors which we conceived to be of permanent value and worthy of careful preservation.

We solicit a continuation of past generous aid and support. This issue very nearly brings our statistical work up to date.

Professor Swezey gives more at length the progress of the Nebraska survey: "At the close of this, the first entire year in which the service has been under the present management, it is fitting that there should be a report upon the

WORK DONE DURING THE YEAR

at the central office. This has been nothing less than the entire overhauling and revision of the reports of observers from the year 1878 down to date with a view to selecting out what was reliable and discarding what was not. Many of the observers were untrained in the careful methods of meteorology to-day. Some did not know how to make averages correctly. Several inquiries, have came to this office "how to average temper-

atures when some were below zero;" and it appears that some, not taking the trouble to inform themselves, had treated such temperatures as if they were above zero. Many such mistakes as this have been rectified and many other observations discarded where there seemed reason to doubt their correctness. The entire mass of individual monthly reports, about three thousand in number, have been gone over, doubtful data eliminated, many of their averages recast, and revised averages made from the whole.

Thus it is believed that the statistics for Nebraska weather for the past eight years have been put into reliable and convenient form for future reference and study, and that the tables here given may be depended upon. Any slight discordances between these tables and previously published bulletins are thus explained.

PROGRESS.

There are now somewhat over thirty stations reporting monthly; they cover somewhat thoroughly the southern two-thirds of the eastern half of the state, although some are scattered through the counties of Lincoln, Red Willow, Keith and Cheyenne in the extreme west. There are three fully equipped stations, viz.: The government stations at Omaha and North Platte and the central office at Crete. Other observers are provided mainly with thermometers and rain guagers only, though several have barometers and maximum and minimum thermometers.

Other observers are desired in all localities, especially the north and west, and any persons who may be interested are urged to correspond with the director on the subject.

PLANS FOR THE FUTURE.

The subject to which particular attention will be turned, now that the statistical work has been put upon a good foundation, will be the display of weather signals in various parts of the state. Several stations are now displaying cold wave flags and arrangements are now being made with the chief signal officer in Washington by which a daily telegram will be sent to this office, and plans are being perfected for distributing the information to various other points."

CHINESE GAME-BIRDS IN THE NORTHWEST.—Judge Denney, formerly consul general at Shanghai, brought back with him to Oregon a number of Chinese pheasants of brilliant plumage. They were kept for a time at Portland, then carried to Protection Island, at the mouth of Puget Sound, whence they are to be distributed over the northwest in favorable localities. The experiment has already been tried with Mongolian pheasants, which has been successful, and the birds can now be occasionally seen in several parts of the State. There is no reason to think it will not be successful with the later addition to the fauna.

TEMPERATURES AT HELENA, MONTANA.—The surveyor-general's office at Helena has continued observations on a maximum and minimum thermometer. The thermometer is of the cheaper sort, but the observations are carefully made, and are consistent in themselves. They complete five full years, extending from August 31, 1878, to September 1, 1883. They are published in a list with a graphical representation of the extremes and averages. The highest temperature reached in these five years was 96°, falling in July; the lowest was 36°, falling early in January. The instrument is at the window of the second story (about fifteen feet from the ground). It shows entire freedom from frost at that altitude for June, July, and all of August but the last week.

THE ARCTIC WILLOW.—Mr. William Bradford, in a paper read before the American Geographical Society, mentions a remarkable fact concerning the stunted willow of the west coast of Greenland, at the base of Cape Desolation (latitude 61°), the shrub is some thirty inches high. The growth of these miniature trees decreases until up to latitude 77° or 78°, when one could crush with his foot a forest of these perfectly formed toy trees. Passing beyond this latitude the size increases again until they reach about twelve inches.

EUROPEAN WEATHER FOR JAN.—*Barometric pressure*—From the 1st till the 9th, several low pressures pass over northern Europe; but on the latter date after a very intense minimum with a

barometer stand in the center of 28.54 near the Shetlands, a high pressure advances from the west (Valentia 30.20 on the 9th.) At the same time another maximum spreads over Germany, while a severe storm has developed over the Adriatic on the 10th; the latter travels in a northeasterly direction, and on the 12th is central near Hermannstadt, Austria; the maximum in the west increases but is pressed down on the 13th on the approach of a very intense minimum in the N. W., a part of which is situated on the 14th over N. W. Germany, causing heavy precipitation over Holland and France; another follows the influence of which is observed as low as southern France; on the 17th the pressure is low over the whole of western, southern and northern Europe. A part of the main low pressure causes snow and frost over the British isles on the 18th; another part causes the same over Germany, so that frost is general on the 20th as far as southern France. This state of weather continues, several small minima traveling over France and Germany, till on the 26th a very high pressure appears in the N. E., with severe frost over Finland, when the frost disappears in the greatest part of central Europe; on the 29th the barometer at Moscow stands at 30.90, while at Homorray, in Scotland, it is at 29.10, and on the 31st at 28.76. On the whole a very stormy month, the barometer everywhere below the mean.

Temperature: Germany.—Above the mean, 1-6, 15-20, 25-31; below the mean, 7-14, 21-24; lowest temperature at Kassel, on the 8th, 8°; highest, 46°, at Chemrith on the 26th.

Ireland, Valentia.—Above the mean, 1-3, 8-16, 28-31; below the mean, 4-7, 17-27; lowest, 31° on the 26th; highest, 52° on the 3d.

Russia, St. Petersburg.—Above the mean, 1-2, 5-7, 10-11, 14-19, 21, 23, 24, 31; below the mean, 3, 4, 8, 9, 12, 13, 20, 22, 25-30; lowest on the 28th, —11°; highest 32° on the 5th.

Sweden: Stockholm.—Above the mean, 1, 2, 4, 5, 8, 9, 14, 26, 30, 31; below the mean, 3, 6, 7, 10-13, 27-29; lowest on the 7th, 2°; highest, 35° on the 16th.

Lapland, Haporanda.—Above the mean, 13-25; below the mean, 1-12, 26-31; lowest, —29° on the 9th; highest, 29° on the 17th.

ROYAL METEOROLOGICAL SOCIETY.—The usual monthly meeting of this society was held on Wednesday evening, the 17th instant, at the Institution of Civil Engineers, Mr. W. Ellis, F. R. A. S., president, in the chair.

Mr. G. Buchanan, M. Inst, C. E., Captain G. H. Leggett, Dr. H. C. Taylor, J. P., and Mr. J. Tolson were balloted for and duly elected fellows of the society.

The following papers were read:

(1) "General Remarks on the Naming of Clouds," by Capt. H. Toynbee, F. R. Met. Soc. The author considers it important to keep to Luke Howard's nomenclature, leaving it to the observer to express by an additional word any peculiarity they may notice in a particular cloud.

(2) "On the Thickness of Shower Clouds," by Mr. A. W. Clayden, M. A., F. G. S. From some measurements made by the author during the summer of 1885, he has come to the conclusion that clouds of less than 2,000 feet in thickness are not often accompanied by rain, and if they are it is only very gentle, consisting of minute drops. With a thickness of between 2,000 and 4,000 feet the size of the drops is moderate. As the thickness gets greater, the size of the drops increases, and at the same time their temperature becomes lower, until, when the thickness is upwards of 6,000 feet, hail is produced.

(3) "On the Formation of Rain, Hail and Snow," by Mr. A. W. Clayden, M. A., F. G. S. The author points out that all observations tend to show that, except under quite abnormal conditions, the temperature of the atmosphere falls as the height above sea-level increases, and there seems no reason whatever for assuming that the law does not apply to that portion of the atmosphere which forms a cloud. Hence if a drop were to be formed at or near the upper surface of a cloud, it would fall down into a region saturated with vapor at a temperature above its own. The result will be further condensation producing a larger drop; and this process will continue until it leaves the cloud. If its temperature is below the dew point of the air it falls through, condensation will continue until it reaches the ground. However, it is obvious that this subsequent gain

cannot bear any very large proportion to the growth while falling through the saturated cloud, from which the conclusion follows that the size of the drop must increase with the thickness of the cloud. The author suggests that condensation begins on the upper surface of the cloud by the cooling of some of the liquid cloud-particles. If this particle is cold enough it will solidify, and snow will be formed. Should it not be quite cold enough to solidify at once, owing to its minuteness, but remain still below the freezing point, hail is formed. Finally if the temperature is not low enough for either snow or hail, rain is produced.

(4) "On Three Years' Work by the 'Chrono-barometer' and 'Chrono-thermometer,' 1882–84," by Mr. W. F. Stanley, F. R. Met. Soc. The chrono-barometer is a clock that counts the oscillations of a pendulum formed by a suspended barometer. The upper chamber of the pendulum is a cylinder of an inch or more in diameter. By change of atmospheric pressure the mercury in the pendulum is displaced from the bottom to the top and *vice versa*. The rate of the clock is accelerated or retarded in proportion to the displacement of the mercury. The chrono-thermometer is a similar clock to the above, and the pendulum is also a barometer, but instead of the lower chamber being exposed to pressure the whole tube is enclosed in a second hermetically sealed tube containing air. Atmospheric pressure being thus removed, the expansion of the included air by heat alone forces the mercury up into the vacuum chamber, and alters the period of oscillation of the pendulum.

Dr. Hinrichs' Work.—In his chronological list, just published, Dr. Hinrichs gives a list of 160 papers published by him from 1856 to 1885. Though some of these are notes and some simply blanks, the list is a remarkable one, and shows extraordinary literary activity. Unfortunately for the bibliographical value of the list in many cases neither place of publication nor other reference is given to the publication farther than the title and year.

That this gentleman's activity was not limited to writing is

shown in the following, which is his own account of the establishment and work of the Iowa meteorological service:

"This service was organized by me in August, 1875. For two years and a half I bore all the expenses, and did all the work of direction and publication unaided. In 1878, the general assembly granted a small annual appropriation, to defray necessary expenses. But no compensation has ever been made for the work that I have continued to do, and which to but a slight extent is indicated by the long list of publications from No. 72 onward. Great financial sacrifices had to be made by me, to obtain the necessary quarters for the central station, and in having to refuse to do well paying expert work for lack of time. Several other states have since in the most essential features copied this system, and the general weather service of the United States has endorsed it. The work of our service is highly estimated the world over, and all meteorological services of note maintain a friendly interchange of publications with us. The climate of Iowa is being studied most carefully, and erroneous notions unfavorable to the state meet with authoritative correction. Very special thanks are due to the volunteer observers of the service, for continued and careful work of observation at the individual stations. Many of these observers have done this work for ten years already."

With this record one would think that Dr. Hinrichs deserved well at the hands of the State, but we learn that he has recently been ungenerously treated. He held positions in the collegiate department of the State university (where the services are paid by salary), and in the pharmacy school (where payment depends only on the fees of students). He has been relieved from duty in the paid professorship, apparently so that he would not neglect work in the unpaid one! Truly, gratitude and appreciation are not universal!

Some Freaks of Ice. Last winter was a very cold one on the Columbia river and they had heavy snow-falls where snow had been unknown for years before. A large ice bed was formed at the mouth of the Sandy river, probably by the driving up of beds of ice by the Columbia at the time of the breakup last spring. The bank was from two to five feet thick and extended half a mile along the river. Afterwards came on cold rains, the Sandy was flooded, and brought down quantities of sand, covering up

the ice bed. It was thus buried and was known to last far into the summer and may be there yet.

The above shows how ice beds may be covered up and thus preserved indefinitely, and so explains the possible mode of formation of ice beds and cold wells in places where permanent ice could not be expected. Perhaps a previous land slide covered up the bed to which the following account is due: In boring for water near Snake River, about 45 miles from Dayton, Oregon, recently, a stratum of frozen earth was encountered at the depth of 55 feet. At a depth of five feet in this stratum, cavities were found, filled with very cold air which rushed out with a roaring sound. Work on the well was abandoned.

Doubtless such patches of frozen soil still exist in places, at depths so great that the melting power of summer warmth fails to reach them. The occasional saucer-shaped depressions in level drift are sometimes explained by geologists as places where masses of ice were left beneath the detritus by retreating glaciers, which masses gradually melted from summer to summer, allowing the surface to settle into a hollow.

In northern Dakota and northward, it is said that a stratum of frozen soil is often met in digging wells, and therefore at no great depth. I have been told by individuals that they have occasionally found it at a depth of only six or seven feet in midsummer. These are cases where the frost fails to get entirely out of the ground all summer. So far as growing crops are concerned this deep frost is not objectionable. On the contrary, as it gradually melts, it furnishes moisture for the roots ot the crops, even in the driest weather. The ground is thus constantly kept moist a short distance below the surface. With such a crop as wheat, the long, clear days, with strong and almost uninterrupted insolation, the deep lying constant moisture without the intervention of rain, and the virgin soil, would together make exactly the excellent and superior growths for which Dakota is celebrated. A secondary result of the frozen layer would be that vegetation which looks thirsty in the forenoon would freshen up in the afternoon of a clear day without rain. The frozen layer would be reached and a part melted in the hottest part of the

day, and the ice, becoming water, would be brought up nearer the surface by the capillary attraction of the loose upper soil. This phenomenon is frequently seen in northern Dakota.

Another freak of ice, of a different nature from the preceding, remains to be recorded. Large numbers of prospectors went into the Cœur d'Alene region in northern Idaho in the depth of the winter of 1884–'85. The snow often lies there five feet on a level, and when there is a break in the forest through which the wind can sweep, it is apt to carry the snow to hollows and ravines, which it fills up. Those who entered this mining district in the winter were carried on the snow over irregularities of the surface which they never suspected until the snow was melted and some trails, good in the winter, were entirely impracticable in the summer. One of the trails led over a ravine about forty feet deep, the very existence of which was unknown to the most of those who crossed it. By compression, and by alternate freezing and thawing, the snow under the trail became compacted into ice, and when spring came and the snow was melted and carried away, over this particular ravine, the ice trail remained suspended as a bridge, and in this condition it stood through the most of the spring. The new trail on the earth was much longer and more difficult than the old, and occasionally a daring miner would cross over on the old trail after it became a simple bridge. So far as width was concerned, it was entirely safe. The only danger was that no one could tell when it had become too weak to support the weight of a man.

THE MOUNTAIN METEOROLOGICAL STATIONS OF EUROPE.

A. LAWRENCE ROTCH, S. B.,
Member of the German Meteorological Society and Fellow of the Royal (British) Meteorological Society.

FRANCE.

The Puy de Dôme.

Situated in Lat. 45° 47′ N., Lon. 0° 37′ E. of Paris, in the Department of the Puy de Dôme, is the highest of a series of volcanic cones, the Puy above having no crater. The land rises gradually from the fertile basin in which lies the city of Cler-

mont-Ferrand, from whence a good road 12 kil. long leads to the Col de Ceyssat (1,078 m.), and above it the symmetrical cone of the Puy, having a slope of at least 30°, rises nearly 400 m., dominating by 200 m. any of the similar ones which surround it. The Monts Dore on the southwest horizon do, however, exceed the Puy de Dôme in height by 400 m. The mountain is clothed with turf, and near the southern base are a few evergreens. A good road, 3 m. wide and 2½ kil. long, passable for wagons, ascends the southwest side in zig-zags, with an average grade of only 1 in 15. The top presents an undulating surface of 8 or 9 ares, with a little mound on the north which seems to be the continuation of the dome.

Meteorological Station.—It was upon this mountain that Pascal, in 1648, caused to be tried his famous experiment upon the weight of the atmosphere, his brother-in-law, Perier, having carried a barometer tube to the summit of the Puy and observed a fall in the mercury of three inches below its height at Clermont. Then for a period of more than two hundred years nothing more was done with the admirable site for meteorological purposes until, in 1869, M. Alluard, professor of physics at the University of Clermont, suggested the erection of a meteorological observatory, and by 1872 the sum of 50,000 francs was obtained from the national government and 25,000 francs each from the department and the city of Clermont. In 1873 the work of excavation was begun, uncovering the ruins of a Roman temple; the road up the mountain, which had been repaired, proving to be an ancient Roman one. The plan of the observatory comprised a round tower on the highest point, a house placed below the summit and a tunnel connecting the two. The light, porous stone found on the top was used for building, the water had to be carried half way up, and the lime, wood, brick, etc., from the base. The observatory was dedicated in August, 1876, and had thus the honor of being the first mountain observatory equipped with registering instruments in Europe.

The observatory proper is above the Roman ruins on the highest northwest point, 1,463 m. above the sea, and consists of a round brick tower with stone trimmings, 9 m. in diameter out-

side, and rising 7 m. from the ground, near which level it is surrounded by a circular corridor enclosing a partly subterranean room intended for magnetic and electrical instruments. These have never been placed there on account of the dampness of the walls inside, notwithstanding their thickness of 1.50 m. This corridor is connected by a tunnel 37 m. long with a two-story brick dwelling house under the shelter of the tower and 15 m. below it, so that communication can always be had without going out of doors. The house is connected by telegraph and telephone with Clermont. The salary of the observer, who, with his family, occupies the house, is 3,000 francs a year, out of which he provides his own food. An enclosed spiral stone staircase 2 m. in diameter, built outside the tower, leads to the instrument room in the second story. On the floor of it are marked the four cardinal points of the compass and opposite each is a window, which, like all the windows of the buildings, is double. To the northwest, opposite the entrance, a door opens into the thermometer shelter, built up with brick from the ground and having openings in the floor for ventilation. Its plan is a half octagon, 2 m. wide and equally high, with a ventilated double roof. The shelter is enclosed by wooden louvres, 6 cm. apart, and the instruments are further protected from the ice and stones which the winds hurl against the shelter by outer metallic louvre-work. The thermometers by Baudin comprise the ordinary wet and dry bulbs, a maximum with air bubble index according to Walferdin's (Phillips') principle, and a Rutherford minimum. Readings are also taken with a sling thermometer outside. A Redier thermograph records the temperature by the difference of expansion and contraction of two concentric tubes, one of zinc, acting on differential gearing, upon paper unrolled by clock-work. An Alluard condensation hygrometer gives the temperature at which dew is deposited upon a metallic box, cooled by the evaporation of ether. A Piche atmometer is an inverted graduated test-tube filled with water and its mouth closed by filter paper. The amount of evaporation is measured by the change of level of the contained water. In the instrument room, at a height of 1,467 m. is a

Tonnelot-Renou standard barometer with a closed cistern and a capacity correction. There is also a Redier barograph, which has a syphon tube that is constantly being raised or lowered on a rack by clock-work. This movement is controlled by a float on the mercury in the short arm of the syphon which engages by a lever either one or the other escapement of a differential gear, according as the mercury in the tube rises or falls. Thus, motion is communicated to a horizontally moving pencil, and the height of the barometer is continually registered on paper moving over a drum. A Hardy anemograph records electrically the velocity and direction of the wind, the direction being pricked on a band of paper every ten minutes, and the passage of the wind over half a kilometer being marked in the same way. The Robinson cups and vane for the purpose are elevated 7 m. above the roof of the tower on an iron column, which, by means of a windlass, can be raised to 9 m. In winter, whenever the temperature is below 0° and the humidity is high, frost-work forms to the length of a meter or more and stops the anemograph. The upper halves of the anemometer cups have been frequently struck by lightning and melted, while St. Elmo's fire is often seen on the metallic points. As a protection against lightning, all the iron-work of the tower is connected with wire cables 2 to 3 cm. in diameter, buried for 100 m. in earth which is always moist, and their ends grounded in copper plates having a surface of 15 sq. m. The roof of the tower is laid in cement, and formerly had turf in the middle on which was placed a registering rain gauge, but this is now removed. There is a parapet around the outside of the tower, marked with degrees, and a telescope can be clamped thereon. As there is no spring upon the summit, the rain falling, not only on the roof, but also on the neighboring ground, is conducted into a large cistern in the basement. The rain and snow gauges seem badly located behind a bank on the north. They are of zinc, with a receiving surface of 4 sq. dcm. elevated 0.75 m. above the ground.

Regular observations are made every three hours from 6 A. M. to 9 P. M., and the record has the following items:—Barometer (reduced to 0°); thermometers (max., min. and sling); hygro-

metric conditions (dew point by Alluard instrument, relative humidity); psychrometer (dry bulb, wet bulb, vapor tension); atmometer; wind (direction to 16 points, force, 0–9); clouds (amount, 0–10, and direction moving); state of sky; precipitation (kind and amount); sun (visible or hidden).

These same observations are made at the Observatory of Rabenesse, in Clermont, 10 kil. in an air-line from the Puy de Dôme Observatory and 1,100 m. below it. This plain station is even more completely equipped than is the mountain station, and is under the able charge of M. Plumandon, while both are directed by M. Alluard. The observations of 6 P. M. and 7 A. M. are telegraphed from the Puy, and, with the corresponding observations taken at Rabenesse, go in the morning to the Bureau Central at Paris and appear in the afternoon in the *Bulletin International.* A dispatch is received at Clermont from Paris in the afternoon, giving the barometric conditions prevailing over Europe that morning. From this data and from the local observations, predictions made for the department are circulated through the newspapers. A verification of 95 per cent. has been attained.

The cost of the Puy de Dôme Observatory has thus far been about 300,000 francs, contributed by the national government, the department and by individuals. It was formerly, together with the Clermont station, maintained by the department at an annual cost of 10,000 francs, but a yearly budget of 26,000 francs is now granted by the French government.

Results of Observations.—The observations have been made on the Puy since December, 1875, and at Clermont since January, 1874. Both series are published annually in the *Annales du Bureau Central Météorologique* and in more detail in the *Bulletin Mensuel* of the same office. The writer thinks there has been no detailed discussion of the results of the observations. The following summary for the Puy de Dôme is for the year 1882. Mean barometer 639 m.m; mean temperature 3.8°, with extremes of —11.0° and 24.7°. The coldest month was December, with a mean temperature of —0.7°, and the warmest July, with 9.0°. The mean relative humidity was 86 per cent. and the

total precipitation on 265 days was 1,764 m.m., which is two and a half times more than the amount caught at Clermont. Though the mean annual temperatures of the two stations differed by 6.5°, the lowest temperature on the Puy is but 0.3° below the minimum on the plain. In this connection, a paper read in 1878 by M. Alluard before the French Academy of Sciences is interesting. M. Alluard there stated that the curves of minimum temperatures for the plain and mountain stations often intersect, both in winter and summer, so that frequently at night it is less cold on the Puy than at Clermont, the difference sometimes amounting to 5°. The curves of maximum temperatures of the two stations do not intersect and are generally nearly parallel. The temperature at night, therefore, varies with the height quite otherwise than during the day, and M. Alluard proposed to establish intermediate stations in order to study the atmosphere layer by layer. The velocity of the wind on the Puy is great, frequently reaching a velocity of 35 m. and having attained a maximum of 53 m. per second.

The Pic du Midi de Bigorre.

This mountain having a sharp conical summit, at an elevation of 2,877 m., is situated in the department of Hautes Pyrénées, in Lat. 42° 56′ N., Lon. 2° 12′ W. of Paris, upon the outskirts of the Pyrenees. It rises, isolated, 640 m. above the "col" which connects it with the chain of mountains on the north, which side is steeper than the south side. From the summit is one of the finest views in Europe; a vast plain stretches away to the north, at a distance of 160 kil. to the northwest is the Atlantic Ocean, while on the south are the Pyrenees, the peaks of equal height lying 30 kil. distant. It is directly in the path of the great atmospheric disturbances coming from the ocean, and being near the road connecting the thermal stations of Barèges and Bagnères de Bigorre it is easily accessible. Owing to its altitude, the Pic is generally 200 m. above the storm-clouds and the snow rapidly melts with the advancing season, rendering a sojourn on it quite possible.

Meteorological Station.—The Pic du Midi had long been visited by savants, but the project of a permanent meteorological

station was not suggested till 1869. In the autumn of 1873 General Nansouty began provisional observations at the inn of Sencours, directly at the foot of the Pic, at a height of 2,366 m. The observations were continued amid great hardships for a period of eight years with but few interruptions. In 1875, after subscriptions to the amount of 30,000 francs had been obtained from the neighboring departments and cities, the observatory upon the summit of the Pic was commenced by General Nansouty and his co-laborers. The summit consists of two pinnacles united by a "ridge." The site chosen was the southern pinnacle, some 11 m. lower than the northern one which has been left free to tourists. The building was pushed as fast as the subscriptions, which finally reached 117,000 francs, would allow, and was completed July 30, 1880, with the distinction of being, as it still is, the highest meteorological observatory in Europe. The difficulties of the construction were great. The work could only be done in summer and the water for the masonry, when snow was not obtainable, had to be brought up from the lake 500 m. below, which made it cost 5 francs the hectoliter. Sand which had a value of 5 francs the cubic meter at Bareges was here worth 120 francs. The stone of which the buildings are made is a sort of limestone, quarried on the summit. The main building is about 25 m. by 8 m., sunk in the rock to a depth of 3 or 4 m., so that the south front presents a façade of two stories above the terrace, while the north back is only one story above the ground. The thickness of the walls in the lower story, containing the kitchen, cellar and storerooms, is 1.25 m., that of the walls above, 0.80 m. Corridors border each side, and between them are the seven sleeping rooms and offices, which are thus kept at comparatively constant temperature. The station room contains a Fortin barometer and a Richard barograph at a height of 2,859 m. above the sea. The roof is of stone, vaulted to secure strength and covered on the south side with tiles, on the north with slate, both being laid in cement, at an expense of 10,000 francs. At each end of the building, and partly underground as a protection from cold, is a cistern holding 50 cubic meters of water which is supplied by the rain and melted snow

from the roof. Iron stoves are used for heating and coke for fuel. The chimneys to insure up-draught have caps pierced with holes inclining upward, through which the winds blow. Electrical storms are very severe on the Pic and the buildings are protected by seven lightning rods which unite with three cables 2 cm. in diameter which descend 1,100 m., partly underground, to the lake of Oncet and into the ravine of Arise, which is always wet from the melting snow. The cost of these conductors was 2,800 francs. A system of 14,000 wire points, covering 640 sq. m. of the northern peak, erected in 1884 to demonstrate Lemström's theory of the aurora, proving a failure for the purpose intended, was connected with the cables and serves effectually to protect the summit from electrical discharges. The observatory is connected with Bagnères by telegraph and telephone. The line passes underground for 5 kil. and is carried the remaining 18 kil. on posts. A zig-zag path 5 kil. long, practicable for horses, descends to the col of Sencours where it joins the paths connecting with the road between Bagnères and Barèges.

The main building is surrounded by a gravelled terrace from which steps lead down to the terrace on the south, and 30 m. to the east a platform 12 m. square and 5 m. higher is reached by steps. These terraces and platforms are solidly built with masonry retaining walls. The platform has in its center a louvre thermometer shelter, open below, after the Montsouris pattern, containing maximum and minimum, wet and dry bulb, and a sling thermometer arranged to be whirled in place. There is also a Richard registering psychrometer. In winter, or when the temperature is below —3°, a hair hygrometer or a Regnault dew point apparatus is employed. A Piche atmometer and Jame's ozone paper are here exposed. Maximum and minimum terrestrial radiation thermometers are placed upon sod and on a post is a solar thermometer with bright and black bulbs in vacuo. The hours of bright sunshine each day are got from a Campbell-Stokes sunshine recorder. A tin rain and snow gauge with an aperture of 3 sq. dcm., enlarged below to prevent the snow from blowing out, is 1.25 m. above the platform. The rain and melted snow are measured in a glass multi-

plying ten times. A vane on a pole gives the direction of the wind, whose force is estimated on a 6-part scale. Observations are made according to the recommendation of the Vienna Congress. The hours are 7 and 10 A. M., 12.9 (for the international series), 4 and 7 P. M., with a special midnight observation, and barometer (reduced to 0°), temperature and hygrometric state of air, hours of sunshine, thermometer (max., min. and sling), ozonometer (0 —20), atmometer, rain gauge, wind, (direction and force), clouds (direction moving and amount), actinometer (bright bulb and black bulb) are recorded. Under "Remarks" are noted the terrestrial radiation, state of sky, etc. The 7 A. M. and 4 P. M. observations are telegraphed to Paris and appear in the *Bulletin International.*

From the north corner of the platform before mentioned a covered stairway leads down to a building about 8 m. square, situated on the terrace below, serving as a chemical laboratory and workshop. By means of a wooden tunnel, this can be united with the main building, and thus the instrument platform, which the winds keep clear of snow, is always accessible, though the snow elsewhere may be 5 m. deep. Work had been commenced in August last upon an astronomical observatory at the western end of the main building. It is to have an iron dome to contain the 6 and 8 inch equatorials which the observatory already possesses. As the clouds are generally below the summit, the sky clear and the air very transparent, the site is expected to be very good. It is intended to make the observatory a resort for all savants who wish to study the phenomena of the higher regions of the atmosphere, and this opportunity for investigation has already been taken advantage of. The cost of the observatory up to the present time has been 280,000 francs. The annual budget allowed by the national government is 30,000 francs. No special sum has been granted for the building of the astronomical observatory. The staff, including M. Vaussenat, who is the director and was one of the founders of the enterprise, the observers, cook and courier, numbers six persons. The nearest station where continuous meteorological observations are made is Tarbes, at an elevation of 308 m., 33 kil.

north. During the summer, observations are made at Bagnéres (555 m.), 14 kil. distant, and at Baréges (1,230 m.), 8 kil. away.

Results of Observations.—The observations are published in the annual volume of the Bureau Central, and M. Vaussenat sends a resumé to its monthly bulletin. The writer has not seen any general discussion of the data. The 1882 observations gave a mean pressure of 540 m.m., a mean temperature of —1.9°, and extremes of —21.7° and 17.8°. The means of the coldest months (February and March) were —7.3° and that of the warmest (August), 6.3°. The precipitation on 192 days reached the large quantity of 2,063 m.m. Previous records show extreme temperatures of —43° and 17°. The southwest wind is the strongest and most frequent, and the northwest the rainy wind. In the storms of December 21, 1884, and March 5, 1885, stones weighing 40 kilog. were moved, from which the force of the wind was calculated at the enormous pressure of 530 kilog. per square meter. The first snow falls the last of August, but does not come to stay until October, from which time it remains until July. Thus, there is about a month and a half without snow, though it freezes each month in the year. As to the value of the Pic du Midi station for weather predictions, it has been found possible to give warning of thunderstorms hours before they reach the plain, and timely notice of floods can be sent out when the snow is observed to be fast melting on the high peaks of the Pyrenees.

Other French Mountain Stations.

The French have done more than any other nation for high-level meteorology. Besides the fine observatories just described, another on Mont Ventoux (1,912 m.), near Avignon, was opened in December, 1884. Its cost was estimated at 150,000 francs and its plan is similar to that on the Puy de Dome. Other high stations are on Mont Pilat (1,434 m.), south of Lyons, in the Cevennes, and those at the military posts on the Ballon de Servance (1,216 m.) in the Vosges, and at Briançon (1,298 m.), report daily by telegraph to Paris. Another station on the Aigoual (1,567 m.) in the Cevennes is already projected.

ITALY

Possesses some notable mountain stations, none of which, however, the author visited. Foremost is the Vesuvius Observatory, 1,300 m. above the Bay of Naples, directed by Prof. Palmieri and possessing some ingenious self-recording instruments. The observatory on Mt. Ætna (2,950 m.), built through the efforts of M. Tacchini, is to be opened next July, and another on Mont Cimone, in the Appenines of Modena, was commenced in 1877. There are also the pass stations of Valdobbia (2,548 m.), Stelvio (2,543 m.) and Little St. Bernard (2,160 m.).

[TO BE CONTINUED.]

OBSERVATIONS ON THE SUN-GLOW AND RELATED PHENOMENA.

Part II.

LUNAR GLOW.

During the winter of 1883–84, several times, I distinctly saw a reddish ring around the full moon of apparently the same size as the solar glow. The attention of several persons was called to this phenomenon and all described it essentially alike. I have not seen this appearance since.

Near the end of November, 1884, I was on the plains about twenty-five miles southeast of Colorado Springs, where we could get a better view of the sunsets than near the mountains. For several days the sun-glow was of unusual intensity and the sunsets showed the most brilliant and beautiful pink, purple and violet tints which I have ever seen. There were no distinct clouds, but a thin haze was in the upper air. The moon was full and of course rose about the time of the after-glow. Next to the moon there was a circle 20° to 30° in diameter, which shone bright white. This was not a lunar halo. It appeared to resemble the white disc next the sun, inside of the chromatic ring, but was larger. This was seen three nights in succession. No colored ring could be made out. I have seen a similar white circle around the sun at times when the colored ring was absent.

CORONAL PHENOMENA.

As already stated, the sun-glow is separated from the sun by about 10° of brightly illuminated sky. On numerous occasions I have seen chromatic tracts around the sun which plainly differed from the reddish-brown glow. The colors are brighter and more prismatic than the glow, and often they show small bright spots like minute solar spectra. They appear in thin clouds, or in hazy areas in the midst of clouds. They often appear not more than 2° or 5° from the sun, and may extend to a distance of 45°, or even more. I infer that they are coronal colors. They may readily be mistaken for the true sun-glow. Sometimes, in rifts of clouds, it is impossible for me to distinguish one from the other. According to my observations, these solar coronal colors appear usually in rain-clouds, and at time of comparatively mild temperature. Again and again I have been able successfully to predict whether an approaching storm-cloud would give us rain or hail, by observing whether the coronal tints or the glow appeared. The importance of these so-called coronal phenomena lies in the following: Ever since I came to Colorado, in 1881, I have each year seen colored tracts near the sun, but I cannot now tell whether they were the true sun-glow or the coronal colors. Several observant gentlemen to whom I had pointed out the sun-glow have said that they have seen the same thing in Colorado for years, but I regard it as doubtful which of these two phenomena they saw. I know that at times it is very difficult if not impossible to distinguish them. All bears upon the question, is the sun-glow really a new thing, or has it always appeared on proper occasion, not being noticed, however, because perhaps not so intense as for the past two years? These coronal colors I regard as different from the iridescent halos. The iridescent clouds observed in Scotland (*Nature*, Dec. 31, 1885, and Jan. 7, 1886,) are probably portions of variegated iridescent halos, such as I have several times seen at this place.

MID-DAY SKY TINTS.

Throughout the winter of '83–'84, that portion of the southern heavens extending for 45° to 70° on each side of the sun and to

an altitude of 20° to 45° above the horizon was perceptibly, often deeply tinted at all times of day, and almost every day. The colors were rather sober reds, more often orange or yellow, sometimes a peculiar cream yellow. These tints were reflected to the eye from distant clouds or when there were no distinct clouds, they appeared to come from a stratum of haze near the southern horizon. The sun-glow appeared in the midst of this tinted tract, quite distinct from it, except beneath the sun, where the two often blended, as was natural, for in this latitude the glow reaches the horizon at the time of the winter solstice. These colors reached two and sometimes three times as far from the sun as the glow, and the depth of color on each side of the sun was but little fainter than beneath it. That portion of the northern sky which was opposite the sun was also tinted to about the same height above the horizon, though often not so long a strip was colored. The color was not so intense as in the southern sky, though of nearly the same tint. As the sun attained a higher altitude these tints became fainter, and about the time of the summer solstice (1884) hardly showed at all. They reappeared during the next winter ('84–'85) nearly, perhaps quite as intense as the year before, but the present winter ('85–'86) they are plainly fainter. I remember to have seen such colors before 1883, but made no careful observations. It seems probable that at the time of the winter solstice, when the light from the sun falls most obliquely, these tints normally appear at places of sufficiently high latitude, though altitude above the sea may also have an influence. During the past two years they seem to have decreased in intensity in about the same ratio as the sun-glow. This is prima facie evidence that the phenomenon has for these two years been related to the sun-glow and probably to the twilight tints also.

THE TWILIGHT TINTS.

The twilight phenomena have been very remarkable during the past two years, but I have discovered nothing new. The order of colors, when best developed at night, have often been seen to be as follows (the same as described years ago):

About sunset the tints are reddish, often golden, yellow and orange. Not long after, these give place to grayish and greenish tints, and then comes the after-glow with reddish colors, rather pure reds, sometimes fire or brick red, sometimes coppery red, etc. When there has been a bright sun-glow, I have often noticed that the region extending from the sun to or a little beyond the outer margin of the colored ring became reddish a little after sunset, and this was all of the sky which was colored at all, unless very faintly. At such times I have noticed that in some cases there were no clouds which could reflect the tints from other directions, at other times there were many.

THE TWILIGHT TINTS AND THE SUN-GLOW.

I have made a very careful study of the relation between these phenomena. They are by no means coincident.

When the sun-glow is of average intensity, then the sunset tints are usually rather faint and occasionally very bright; when very intense they are almost always very faint; when faint or absent they are frequently brilliant. It has long been known that brilliant sunsets almost always betoken fair or windy, dry weather. My observations show that a marked increase in the intensity of the sun-glow forbodes a storm or a cold wave. This seems to show that the sun-glow and the twilight tints are in some respects very different phenomena. Usually the conditions most favorable for the one are least so for the other.

THEORIES.

This paper is already too long, and many points must be omitted. For the same reason there can be no adequate discussion of theories. This is the only part of my subject which requires me to refer to the published views of others, but references must be omitted.

Several hypothesis as to the origin of the sun-glow present themselves.

(*a.*) The glow may be due wholly to diffraction, 1°, upon volcanic dust, mixed, perhaps, with other dust normally present in the air. The dull color of the glow is in favor of this hypothesis; also the wonderful intensity of the glow immediately after

the great volcanic eruptions of 1883. The same sort of diffractive ring is said to have been produced artificially. But if this hypothesis be true, we must still account for the great increase in the intensity of color at times when a cold upper stratum is in a state of unstable equilibrium with a lower, and they are about to break into a storm. Three theories occur to me.

1. That cold air contracts and dust particles in it are brought nearer to each other, thus increasing the diffractive effect. But the changes in the intensity of the sun-glow are so rapid and so great that it is unlikely the amount of change caused in this way can account for so great variations in color.

2. That the diffractive effect is very nearly constant and that the apparent variations in intensity are due to variations in the transparency of the air. Thus, for instance, it may be said that the air before a cold storm is more transparent to the diffraction colors, and therefore they appear more intense. That the transparency of the lower air varies greatly must be admitted. But it is by no means proved that the air is always unusually transparent when the glow is most intense. I have often seen a very bright sun-glow when even the neighboring mountains not more than five or ten miles away appeared quite dim. This observation has been repeated many times, and I affirm it with the greatest confidence. On the other hand the sun-glow has often been absent when the appearance of the mountains showed that there was very little haze or smoke in the lower air. For instance, on the morning after the long cold storm of February, 1884, referred to elsewhere, there was no sun-glow all the forenoon, yet the Spanish Peaks appeared very plainly—as plainly as ordinarily the Greenhorn Range does. And in the afternoon when the glow was brilliant none of the mountains in sight from Colorado Springs showed dim in the least; though a haze could be made out in the upper air. While then there is nothing more certain than that there are variations in the transparency of the air whereby a varying proportion of diffraction colors in the upper air would be transmitted to the earth, yet my observations do not permit me to refer all these changes in the glow to this cause.

3. That the diffraction color is practically constant, but that it appears to us most brilliantly when there is a haze or cloud of the proper tenuity to reflect the light to us, combined perhaps with coronal effects in some cases. This no doubt is one cause of variation in intensity of the glow, especially near a cloud, but probably not the only cause.

2°. That the glow is caused by diffraction upon both volcanic dust and extremely small ice-crystals or grains, the color due to the dust being nearly constant and rather faint, that from the ice varying according to the conditions of precipitation. On this hypothesis the absence of the glow would be due to the absence of ice particles of the right sort, the constant diffraction color of the dust being at the same time absorbed in the air before reaching the earth.

3°. The glow may be due to ice particles alone. Both the white and iridescent halos are undoubtedly caused by refraction, reflection and dispersion by ice crystals. It remains to be proved that ice particles or grains may be of such size or shape that they can give a brown diffraction color. The white central circle next the sun is rather in favor of the theory that ice or water is concerned with the phenomenon in some way.

Prof. Kiessling of Hamburg attributes the after glow to reflection and diffraction from a horizontal layer of ice particles at a high elevation. *Nature*, Oct. 29, 1885.

4°. Some or all of the dust particles at high elevations in the air may become coated with ice, and the glow may be due to diffraction upon such masses. It has been proved that dust favors precipitation, a fact favorable to this theory. This theory would also be consistent with the great intensity of the sun-glow after the great eruptions of 1883, also with the increase in intensity at the commencement of the precipitation preparatory to a cold storm. A point against it will be named in connection with the next theory.

(*b*) The glow may be due partly to diffraction and partly to dispersion and refraction—perhaps the latter combined with absorption.

If we assume that the dust particles of the upper atmosphere

may become coated with ice, it follows that in the sunlight the dust will absorb some of the solar rays which reach it, whereby the dust grain would become warmed and tend to melt and evaporate the ice deposited upon it. With each such particle therefore, there might be an intermediate state where dust, ice and water would all be in contact and the optical phenomena correspondingly complex, the process of diffraction being combined with refraction, dispersion and absorption.

(*c*) The glow may be due to combinations of two or more of the above-named conditions, assisted perhaps by the gases of volcanic eruptions or by unknown elements.

(*d*) That the glow is the result of the united action of causes tending to produce iridescent halos, coronal colors, and twilight tints simultaneously.

Where so little is known with certainty it is not best to dogmatize.

Assuming that the colored tracts seen near the sun prior to 1883 were what are here called coronal and were not the true sun-glow, also assuming that the changes of intensity from day to day of the sun-glow are not entirely due to changes in the transparency of the lower atmosphere, or to reflection from vapors or haze in the lower air, then I incline to the hypothesis that volcanic dust is largely concerned in the production of the glow, but that its effect is combined with some peculiarity of precipitation of moisture. And perhaps the most plausible theory connecting the action of dust with precipitation, that is, in a causal relation, and not as contemporaneous merely, is that moisture condenses upon the dust, is in turn melted wholly or in part by the heat of the sun, often freezes again in irregular or globular form, thus no longer acting like ice crystals to produce distinct halos, but producing a complex result, combining diffractive effects with several other optical effects.

Finally, I am more and more suspecting that the sun-glow is as normal and constant as the twilight tints, though like them intensified by the great eruptions of 1883. But it may not usually appear more than a few times a year, on the occasion of a few of the most violent cold storms. G. H. Stone.

LOCAL STORMS IN OREGON AND WASHINGTON.

It is often claimed that the extreme northwest corner of the United States is free from local storms, and this claim deserves examination. Nothing can be gained permanently by misrepresentation, and an exact statement of facts, even though unfavorable, is always best. In this case the statement is not an unfavorable one, though less favorable than the claims of some mistaken friends of the region under consideration.

The following are the gleanings from a few newspapers of Oregon and Washington for the year of 1885 alone. The search was a desultory one except in the case of the Portland *Oregonian*, of which a file of the weeklies for the year was examined with care. A few notes from British Columbia are also inserted.

It is well known that thunderstorms are rare on the Pacific coast, from Lower California northward. They are not however unknown. In Oregon and Washington, each, there are on the average five or six days of thunderstorms throughout the year. These storms are usually not destructive, but injury sometimes results. A barn was struck on Whedby island about the middle of June, and set on fire. A heavy storm of this character passed over Seattle on Aug. 1, when lightning struck several places. At Victoria a thunderstorm occurred June 11, of which the electric phenomena were unusually vivid, as may be seen from the following cutting: "The heavens present an extraordinary appearance to-night. Lightning is flashing incessantly from every quarter of a perfectly clear and star-lit sky. The flashes are so brilliant at times as to dim the electric light by comparison, and to be painful to the eyes of those who behold them."

In passing I may note that at Victoria the most severe and destructive thunderstorms remembered occurred in July or August, 1858. They have had only one serious one since. They are most frequent in February. This relates only to Victoria; in the Columbian mountains they are very common.

Hail-storms are also not unknown. Oregon has two or three a

month, in the settled regions, and Washington four or five. Some of these are destructive, though the number is small. On June 12 a severe hail-storm did considerable damage to crops in Wild Rose valley, Washington. On July 10 occurred a severe one at Spokane Falls, said to be the worst ever known there. It lasted about fifteen minutes, left a layer of large hail-stones an inch or two deep, and did great damage to vegetation. On Nov. 4, hail of large size fell at Astoria, and on the 8th a severe thunderstorm with hail occurred at Tatoosh Island, Washington. The hailstones were large and fell to the depth of half an inch.

The following is an account of an Oregon cloud-burst, evidently the same phenomenon as goes under this name and occurs so frequently in the territories farther east. The date is July 6: "The most destructive cloud-burst ever known in Grant county occurred last Monday, and extended over twelve miles in length. Rocks weighing tons were washed loose on the hills, and came down like an avalanche, sweeping away fences, houses and groves; dry gulches were filled and overflowing; the smallest rivulets became roaring torrents. Below the immediate scene of the flood the river raised ten feet, covering meadows and destroying the growing crops. The damage will be several thousand dollars."

It is apparently the same storm which reached Asoten Co., Washington, and did much damage. It there took on more of the character of a tornado. Asoten Co. suffered the year before from a serious tornado.

A whirlwind visited Astoria on Sept. 15, leaving a path through the timber and doing some other damage. Its character can be judged from the following clipping. "At Alderbrook, a short distance above Upper Astoria, August Norburg has been putting up a two-story dwelling, 36x54 feet, which was almost finished, the doors and windows remaining to be put in. Yesterday he and a carpenter named John Holmgren were at work in the building, when as quick as a lightning flash a gust of wind from the south struck the building, which collapsed and fell in a shapeless mass. Men who heard the crash

ran to the spot and succeeded in getting Norburg out unhurt. Holmgren was struck and held down by some of the heavy timbers, and when found was in a sitting posture, wedged tightly between some beams. Such furious blows of wind are fortunately infrequent. The air was still immediately before and after the miniature cyclone, and nothing else in the vicinity was disturbed except some trees growing near the house, which were torn up by the roots in the rush of the whirlwind which there spent its force."

In October, less than a month afterward, a similar phenomenon occurred further south. The local account and comments are as follows: "On the 9th inst. a portion of the people of Springfield precinct were treated to a young tornado. The first indication was a funnel-shaped cloud passing through the sky rapidly. The wind began to blow furiously, and first commenced its work at George Ebbert's place, blowing two or three different fences several yards. At Mr. J. H. Goodman's place the wind blew a plank fence away and then struck a workshop and took it up in the air and carried it at least fifty feet and broke the plank in the same into splinters. It next struck a flock of sheep and carried them in the air for fifteen yards, but did not kill any of them. It is the general opinion that the storm was of a cyclonic nature. Nothing of the same kind was ever seen in Lane county heretofore. Can it be possible that Oregon will be subject to eastern tornadoes in time?"

In addition to these tornadic storms, they also have gales, and these are not rare on the seaboard. The two following will illustrate their character. The first was on Nov. 17 at Portland: "The warm Chinook breeze which blew pretty fresh all Tuesday evening, was changed into a snorting little hurricane from the southwest during the night, and continued until late yesterday afternoon. The movements of some of our smaller craft were delayed, although the Zephyr, Emma Hayward, and several other stern wheelers, left their respective berths on time. The surface of our usually placid bay was considerably ruffled, and white caps could be seen from shore to shore. But little damage was done so far as reported, the most serious being the

damage to the tin roof of the Denny school house. All the tin on the northeast corner of the roof was ripped off, and damaged to such an extent that it will have to be replaced by new tin. The barrel factory smokestack gave way under the unusual pressure upon it, and fell to the roof of the factory."

The following relates to a gale at Astoria on Nov. 22 and before: "Succession of strong northeast gales accompanied by heavy squalls have prevailed here since sundown yesterday. Between 9 and 10 last evening a large frame building built on piles over the water and used as a mess house for men employed by the Clatsop Mill Company, came down with a crash during the heavy squall. Fortunately not many of the occupants had retired and all but three men escaped without injury. Three were injured by falling timbers; two not very seriously, but the third, a Russian Finn, name unknown, had to be conveyed to St. Mary's hospital. It is hoped his injuries will not result fatally.

"Mr. Grimes, the mail carrier from the Seaside, reports that about 9 P. M. Sunday a squall struck the large addition being constructed at Grimes' summer house, leveling it to the ground and shivering the timbers to pieces. There is no damage to shipping in the harbor, but heavy seas rolling in caused vessels moored to the docks to surge heavily against the wharves."

From this sketch a fair idea can be drawn as to the frequency of destructive storms in the Northwest. It is probably a fair average representation. That they are not free from these storms is evident, but it is also evident that these storms are there infrequent and not so destructive as in the states east of the Rocky mountains. I have taken care to select the cases occurring in districts already settled or capable of settlement. Of course the weather is much rougher in the mountains.

M. W. HARRINGTON.

LITERARY NOTES.

(212) **The West Shore.** This excellent monthly journal is devoted to the resources of the Pacific Coast, especially of the Northwest. It is published by L. Samuel at Portland, Oregon, and is now in its twelfth year. It is full of excellent cuts and authentic information and should be in the hands of all who are especially interested in the Northwest. H.

(213) **Ciel et Terre.** Nos. 13, 14, 15. *The leading article* in No. 13, of this periodical is on "Mountain Observations" taken from the *Edinburgh Review.*

(214) **A. L.**, has a paper on *Atmospheric Electric Discharges* in Belgium during the year 1884. Of the 197 cases, of damage by lightning, reported to the Observatory, 55 resulted in fires. Nearly 100 persons were struck, of this number 19 cases proved fatal. The writer also states that on June 28, during the passage of a thunder-storm, a remarkable example of the phenomenon known as St. Elmo's Fire was noticed between Alost and Denderleemo. From the top of each telegraph pole the fire was observed to ascend for a considerable length of time. S.

(215) **O. Montigny.** *De l'accord entre les indications des couleurs dans la scintillation des étoiles et les variations atmosphériques.* The relative frequency of the colors red, orange, yellow, green, blue and violet in a scintillating star is found to depend not alone upon the character of the light of the star, or upon the star's distance above the horizon, but, above all, upon the condition of the atmosphere. To simply see the variations in color the observer has but to give a vibratory motion to the telescope, thus causing the image of the star to describe an apparently continuous curve, different portions of this curve will be differently colored. In his researches upon the scintillations of the stars the author soon noticed that on the approach of rain, and especially after the rain had already commenced, the blue predominated over the other colors, while during fine weather there would be an excess of green and violet. As to whether it always rained within a day or two after an excess of the blue was noticed, the writer states that for those exceptional cases in which no rain fell at Bruxelles it almost invariably did rain at one of the three neighboring stations which reported to the Observatory. It appears to be a well known fact that the blue of the firmament and of mountains near the horizon, increases with the amount of moisture in the atmosphere. After showing the agreement between his predictions and the actual data desired from observation the author formulates a law the substance of which has been given above.

(216) **Les dernieres recherches sur l'électricité atmospheriques.** This paper contains a brief review of the labors of Lemström and Palmieri, both well known to the scientific world; the former through his

celebrated experiment on the artificial production of an aurora, the latter, through his work at the observatory on Mt. Vesuvius. S.

REVUE COLONIALE INTERNATIONALE. Amsterdam, J. H. de Bussy, 60, Rokin, Octavo, 6 numbers, July to December, 1885, pp. 1–496. It is with sincere pleasure that we call the attention of our readers to this excellent journal. It was founded by the Netherland Colonial Association at Amsterdam, and is edited by Professor Kan of the University of Amsterdam, Professor Van der Lith of the University of Leyden, and Counseller Jitta of Amsterdam. Dr. H. C. Rogge, Conservator of the Amsterdam Library, edits its monthly bibliography. Under such distinguished direction, its merits would be assured, but it has fairly surpassed expectation. It is devoted to Colonial matters of all kinds, policy, history, commerce, geography, climate, etc. Its contributors are men of eminence and its articles are indifferently in English, French and German, with perhaps the English preponderating. We commend the journal unreservedly to our readers. We give below a list of such articles as contain matter of especial geographic or climatic interest. A not inconsiderable part of the value of the journal is to be found in its monthly bibliography which is quite complete and well indexed.

(217) **E. Levasseur,** *Les forces productive de l'Australasie Britannique*, pp. 26–43, 123–140, 211–232. This is a valuable discussion of social statistical aspects of Australasia. It is well illustrated by graphic plates and considers the population, immigration, mortality, density of population, immigration, policy, sale of lands, administration, agricultural and mineral productions, roads and commerce.

(218) **F. Blumentutt,** *Die Mestizen der Philippinen Inseln*, pp. 253–261. The mestizoes, very common in Spanish America, and making up a large proportion of the population, make but four per cent. of it in Spanish Asia. This is partly due to the small number of Spaniards actually living in the Philippine Islands, and partly to the fact that a religious calling is there easily open to them. At present the Chinese mestizoes are ten to fifteen times as numerous as the Spanish.

(219) **J. G F. Riedel.** *The Soawu or Haawu Group, with a sketch map*, pp. 303–311. This is a small group of islands at the eastern end of the Moluccas, south of Flores and east of Timor. It is a part of the Dutch possessions. The inhabitants number 23,026, of whom 2,497 are Christians, and none Mohammedans. An interesting account of their customs is given.

(220) **Franz Ri ter von Le Monnier,** *Eine Vergessene Holländische Colonie*, pp. 345–360. The colony was on Formosa, an excellent geographical sketch of the island.

(221) **A. Woeikof,** *Les Européens dans les tropiques*, pp. 466–477. This is a discussion of the healthfulness of the tropics for Europeans. The author does not believe that the tropics are necessarily unhealthy, but

that, on the contrary, they present some advantages as places of residence. The causes of the unhealthiness of the tropics for Europeans is to be found in something else than the heat. The life led by Europeans in the tropics has much to do with it. They do not adopt suitable food and clothing, but try to live as they did in Europe. This is easily remedied. The diseases due to microscopic organisms are also worse in the tropics, but as to these, they are in the first place largely due to bad water, and, in the second place, they can now be much better controlled than formerly. The Chinese and Jews spread from the equator to high latitudes and much could be learned from them as to the proper mode of life in the tropics. The Mosaic laws and the Jewish customs are, in the opinion of the author, (and in that of the reviewer), favorable to longevity in any latitude. H.

REPERTORIUM FUR METEOROLOGIE. Published by the Russian Imperial Academy of Sciences and edited by Dr. Heinrich Wild, Member of the Academy and Director of the Physical Central Observatory. Vol. IX, St. Petersburg, 1885. Quarto, 584 pp., 13 maps, 4 plates.

(222) **H. Rykatschew.** *Erdmagnetische Beobachtungen am Kaspischen Meer im Sommer 1881.* 51 pages, 2 plates. These are the results obtained by the author during an inspection journey to the Caspian Sea in 1881. Observations were taken at eight stations, including Astrakhan and Baku. The reductions are made with very great care, as apparently were also the observations.

(223) **P. Braunow.** *Ueber den jährlichen Gang der Temperatur-Anomalien in den Europäischen Cyclonen.* 19 pages, 1 table. The author has studied the distribution of temperature in cyclones in Europe. This is his second publication on the subject. In his first he showed the average position of highest and the lowest temperature in a cyclonic area, and in this he treats of the seasonal relations of cyclonic to normal temperatures. The results are interesting and will be reproduced at some length elsewhere.

(224) **R. Bergmann.** *Ueber die Zuverlässigkeit der Haarhygrometer auf den meteorologischen Stationen in Russland.* 30 pages. On account of the well known difficulty of getting correct results from the psychrometer at low temperatures, the Russian stations, especially the northern ones, are provided with hair-hygrometers. After a careful study of them the author concludes that a well made hair-hygrometer will be fairly constant for a varying period, usually over a year, averaging eighteen months, at the end of which time it should be gone over by a skillful mechanic. He also finds that they are somewhat uncertain in their action in extreme dry or wet weather. Taken altogether the author makes the hair-hygrometer a better instrument than is usually thought.

(225) **A. v. Tillo.** *Resultate die von I. N. Smirnow in den Jahren 1872–78 in Europäischen Russland ausgeführten Bestimmungen den*

Magnetischen Horizontal-Intensität. 54 pages. The observations of Prof. Smirnow (now deceased) on the horizontal intensity of terrestrial magnetism are of especial importance. They were numerous (being taken at 293 places). They were taken within seven years and are, therefore, nearly free from secular change. And they were taken by one observer with one set of instruments and are, therefore, strictly comparable. Dr. von Tillo, who reduces and discusses them, is a very prominent student of Russian terrestrial magnetism.

A. v. Tillo. *Ueber die geographische Vertheilung und säculare Aenderung der erd-magnetischen kraft in Europäischen Russland.* 78 pages, 3 maps. A renewed study of the terrestrial magnetism of Russia, with fine illustrative maps.

(226) **M. Rykatschew.** *Nouvelles cartes magnétiques de la mer Caspienne.* 56 pages, 3 maps. A detailed study of the terrestrial magnetism over the Caspian Sea, in the light of the new observations.

(227) **I. Spindler.** *Die Vertheilung der Winde an den Küsten des Schwarzen und Asowschen Meeres.* 56 pages, 6 maps. This is the first elaborate study of winds on the Black Sea and Sea of Azov. The average winds turn, in passing along the coast, as if the Black Sea were occupied by an area of minimum pressure, and this is found by other means to be the case. There are many changes due to the season and to the position of cyclones or anti-cyclones on the European continent. The land and sea breezes are well marked.

(228) **A. Schönrock.** *Ueber kleine unregelmässige Barometer-Schwankungen.* 10 pages, 1 plate. The author makes a statistical and comparative study of the mysterious little irregular barometric perturbations or tremblings which are best known as accompanying thunderstorms. He finds, by a study of barographic records, that they are by no means rare phenomena. On the contrary they occur often in the year and are very common even in winter. In frequency they have two maxima (a summer and a winter one) and two minima (spring and autumn), and they are apt to occur with precipitation or with nimbus cloud. They occur in connection with great depressions and are likely to be found in many places at the same time. They are most common at the edge of a cyclone, or of an anti-cyclone on the approach of a cyclone. Between cyclone and anti-cyclone are apt to occur remarkable irregularities of the isobars, and the phenomenon makes as a whole the impression of an unstable equilibrium of the atmosphere covering a great area. The occurrence of this phenomenon appears to favor highly the appearance of clouds and precipitations, and also the formation of thunder storms.

(229) **H. Wild.** *Einfluss der Qualität und Aufstellung auf die Angaben der Regenmesser.* 23 pages. After a review of the evidence collected by himself and that published elsewhere, Dr. Wild concludes that

if we would avoid a relative error of 5% in the yearly totals and of 10% or more in the monthly totals of precipitation, we must have a more uniform height and manner of exposure of rain-gauges.

(230) **H. Wild.** *Jahresbericht des physikalischen Central Observatoriums fur 1883-84.* 114 pages This is the report of the Russian Weather Service, made to the Imperial Academy. The central observatory publishes annals, the repertorium and observations in marine meteorology. Its activity is very broad and it pays especial attention to terrestrial magnetism. In 1883-4 it received observations from 225 stations, scattered from Peking to Warsaw and from Teheran to Archangel. A telegraphic weather service is kept up; the percentage of verification of weather predictions in 1884 was 56%, of storm signals 49%. Special observations are made on thunder-storms, and this department of the work is under Mr. Lamanskij.

(231) **E. Leyst.** *Untersuchungen über die erd-magnetische Horizontal-Intensität in der Umgegend des Observatoriums zu Pawlowsk.* 15 pages, 1 map. Local influences on the magnetic horizontal intensity at Pawlosk are unusually small, and are of a purely geological character.

(232) **B. Sresnewsky.** *Barometrische Bestimmung des Meereshöhe des Onega-Sees.* 16 pages. Lake Onega, about 200 miles north-east of St. Petersburg, is 25 feet above sea-level. Mr. Bergmann determines that of Ladoga Sea, just north-east of St. Petersburg, is about 16 feet.

(233) **Ed. Stelling.** *Verifikation Robinsonscher Anemometer bei grossen Geschwindigkeiten.* 30 pages. Dohrandt's formula with three constants should be used in correcting the reading of Robinson's anemometer for high velocities. Even then the results are not entirely correct, and the only safe way is to test each instrument for various high velocities. H.

(234) **Lehrbuch der Meteorologie.** *Im Auftrage der Direktion der Deutchen Seewarte,* bearbeitet von Dr. A. Sprung. Mit 88 Illustrationen im Text und 17 Taffeln. Hamburg, Hoffman und Campe, 1885.

So great have been the advances in all branches of meteorology, and especially in the mechanics of the atmosphere, during the last quarter of a century, that these, taken collectively, have sometimes been called the new meteorology. These advancements have been made by different investigators in different countries, and have heretofore been found only in scientific papers in the different languages of these countries. This is the first attempt to systematize and to collect together the results of these various researches into one volume. For this work the author is eminently fitted, for he has not only always kept fully abreast with all the recent advances, but has also himself made important contributions.

It would be inconvenient to give here any general idea of the contents of the book, comprising so much upon the different branches of the subject, further than can be gleaned from the mere headings of the different

parts and chapters into which the work is divided, which are as follows:

INTRODUCTION. This treats of the motions of solid bodies on and near the earth's surface under the influence of the force of gravity and of the earth's rotation, temperature and heat, the laws of gases, the mechanical theory of heat, and the aqueous vapor of the atmosphere.

PART I. The statics of the atmosphere.

PART II. The dynamics of the atmosphere.

Chapter I. Conditions of the origin of atmospheric currents.

Chapter II. The horizontal components of air currents.

Chapter III. The vertical components of air currents.

Chapter IV. Atmospheric circulation.

Chapter V. The progressive motions of atmospheric whirls.

Chapter VI. The weather phenomena as a result of the progressive motions of atmospheric whirls.

Chapter VII. Secondary phenomena of air pressure.

PART III. Solar radiation and its periodic effects.

Chapter I. Introductory considerations.

Chapter II. The diurnal periods of the meteorological elements.

PART IV. Periodical phenomena which do not depend upon the earth's rotation upon its axis, or revolution around the sun.

PART V. Researches concerning the variability of the meteorological elements without regard to the underlying causes.

The work concludes with an appendix and a copious alphabetical index.

It is seen that the work pertains mostly to the dynamics of the atmosphere, and that the whole subject is treated in text-book style, that is, by commencing with special and more simple cases and going up to the more general. This is rather a necessity and not a fault under the circumstances, and is a feature of the work which is best adapted to, and will be appreciated by most readers. In a strictly scientific treatise for readers who can grasp the whole subject at once in its most general form, the reverse method is preferable, in which the most general case is first considered, and all the special and less general cases then deduced from it by way of corollary. In this way the statics of the atmosphere and the motions of a solid body would become special cases of the more general one of the dynamics of the atmosphere.

The work is not merely a treatise upon the subject, but it is likewise somewhat historical, giving, with all due credit, the parts which the several investigators have, at different times, contributed to the general advancement. Although this destroys somewhat the unity of some parts of the work and makes it less concise, and consequently increases the bulk of the volume, yet with many readers, in the present state of advancement of subjects mostly new, this will enhance the value of the work. It will be seen that, upon the whole, there is now a remarkable

agreement amongst the different investigators upon all the principal points, and only a few of minor importance remain yet to be settled.

The work is not a complete treatise on meteorology. It is rather a treatise on the higher meteorology only, comprising mostly the recent advances, and must be regarded as a supplement to more elementary, and merely descriptive treatises, of which we have a number, very good so far as they go, but which, as well as the more comprehensive treatises of Kæmtz and of Smith, are now very far behind the times, regarded as complete treatises.

No worker in meteorology, or any one in any way interested in the subjects, can afford to be without Dr Sprung's book, in which is collected into a small compass so much from different quarters, and made so accessible and convenient. W. FERREL.

(235) **United States Coast and Geodetic Survey.** *Report of 1884.* This report is probably the most voluminous of any yet issued. Of the special scientific work of the year were Determinations of Gravity and Comparisons of Standards; Projection Tables and Formulæ and Factors for Latitude, Longitude and Azimuth Computations, based on the Clarke spheroid; The Run of the Micrometer; Geology of the Sea Bottom in the Approaches to New York Bay; and Depths of the Sea in the Bay of North America and the Gulf of Mexico. In Appendix No. 1, is detailed the general work of survey extending from the north-eastern part of Maine, along the coast line to Alaska, and also work covering a considerable portion of the interior. New Projection Tables appear in Appendix No. 6, and cover the entire distance from the equator to the poles.

In Appendix No. 17, which is devoted to a description of a model of the depths of the sea in the bay of North America and Gulf of Mexico, the author, J. E. Hilgard, Superintendent, says a "remarkable feature brought out by the model is the relative insignificance of terrestrial elevations contrasted with oceanic depressions. An elevation of 600 feet, equivalent to 100 fathoms, takes in the Atlantic plain, the Mississippi Valley, and the Texan plain, and reduces the continental area represented by about two-fifths." In an addendum to the article he further says, "Assuming then the ocean to *rise* 600 feet, one would find Nova Scotia not only separated from the continent, but broken up into a number of small islands. The height of 600 feet will carry us up the Saint Lawrence to the Falls of Saint Mary's, between Lake Superior and Lake Huron, taking 602 feet as the elevation of Lake Superior and 581 as that of Lakes Huron and Michigan. The waters of the Saint Lawrence would be united with those of the Hudson by two channels, by the Lake Champlain and Mohawk valleys, which rise to the moderate heights of 152 and 430 feet, respectively, Lake Ontario being 247 feet. But the great lakes would also communicate directly with the Missis-

sippi system, the 'divides' in the vicinity of Chicago being only 7 and 9 feet above the surface of Lake Michigan."

Appendix No. 19 is of great historical value and consists of a "History of Discovery and Exploration" on the Coasts of the United States, by J. G. Kohl, Ph. D., extending, chronologically, from the year 982, to 1847.

Numerous valuable maps and illustrations complete the volume.

A. W. N.

(236) **H. Allen Hazen.** *Thermometer Exposure.* Professional Papers of the Signal Service. No. XVIII, prepared under the direction of General W. B. Hazen, Chief Signal Officer, and published by the authority of the Secretary of War. Washington, Signal Office, 1885. Quarto, 32 pp., several wood cuts. Professor Hazen has for a long time made a study of the problem of ascertaining the temperature of the air. The question is first asked, What is meant by air-temperature? and to this is properly given the answer, the temperature of the lower layer of air free from local radiations and reflections. The influences of locality, shelter, and other surroundings on this temperature are carefully studied, and as a result, a new form of shelter is deduced for the use of the observers of the Signal Service. The window-shelter is done away with and the new one is to be on the roof and is a small house three feet high, three and one-half by three feet horizontally. It has a double roof, sloping to the rear, a door consisting of the front to be let down, and walls of slat work. It is to be on a frame nine feet above the roof. If on sod, it is to be sixteen feet above the surface.

In appendix A the anomaly of the wet bulb thermometer of the psychrometer sometimes, in cold weather, giving readings above the dry bulb, is briefly considered. The author attributes it to the compression of the ice-sheet on the wet-bulb and finds the elevation never more than 0°.6. The compression begins at 24° and increases rapidly to 0°, when it causes an elevation of 0°.5. From that to −20° it does not change materially, but rapidly yields when the thermometer is warmed again. In the other appendices are briefly discussed the temperature of sod and the air in contact with it, the influence of the forms of thermometers and of the brass scales, and, finally, a series of comparative observations on psychrometers in the sling and in the standard shelter. H.

(237) **Sixth Annual Report of State Board of Health, etc., of Massachusetts.** *Supplement containing the Report and Papers on Public Health.* Boston, 1885, Octavo, pp. 403, with many charts and diagrams.

This is one of the most valuable sanitary annuals of the United States. It contains the results of careful studies of various questions relating to public health. This number contains the reports of studies of the sanitary condition of school-buildings in Massachusetts, analyses of foods, milk and drugs, the relation of illuminating gas to health, poison-

ous effects of coal and water gas, epidemic cholera, disinfection, the health of Taunton and other towns, etc. Thirty or forty pages are devoted to a summary of the weekly mortality reports of Massachusetts cities and towns, and in this part are included the necessary meteorological data. The volume should be in the hands of all sanitarians.

H.

(238) **Twelfth Annual Report of the Secretary of the State Board of Health of the State of Michigan, for the Fiscal Year Ending September 30, 1884.** This valuable report is another stepping stone in the history of the advancement of our state in matters pertaining to public health, and exhibits throughout the careful labor and supervision of Dr. Baker, the able secretary of the Board. Its 300 pages and over also show the great diversity of labor which the broad field of sanitary science and public health calls forth. In addition to the secretary's own introductory report, the volume contains a number of valuable papers, among them Dr. Baker's study on "Typhoid Fever and Low Water in Wells," and his report on cheese poisoning.

Special attention is given, as in preceding reports, to the subject of climatology and to the relation of sickness to climate in Michigan. Including signal service stations there were about 30 different meteorological stations in Michigan from which reports were received at the office of the State Board of Health in 1884. Sixty seven pages are devoted to the consideration of meteorological data, independent of its relation to sickness; and about 30 pages of the report to the study of climate and sickness together in Michigan, based on reports from meteorological observers, and on reports of sickness from different parts of the state. The present volume is a credit to the state as well as to the board issuing it.

A. W. N.

(239) **John Ruskin.** *The Storm Cloud of the Nineteenth Century.* Two lectures, delivered at the London Institution February 4th and 11th, 1884. New York: John Wiley and Sons, 1884. Octavo, pp. 111. This is an amusing book as well as a suggestive one. Science and its votaries receive their usual trouncing at the hands of Professor Ruskin. As the scolding, however, shows an entire lack of appreciation of what science is, and as the punishment has been often administered before by the same hands, the reformatory effect will probably not be great.

The book is well worth reading for its suggestion of a new cloud form, now not a score of years old. An artist is even better able to judge of a new cloud form than is a meteorologist. The author thinks that, since about 1870, a plague-cloud and a plague-wind have arisen and developed in Western Europe. The cloud is characterized by great extent, persistence and an absence of the usual beautiful colorings of previous clouds. It deadens the light, dirties sky effects, and deprives the sun of its brightness. The wind may come from any direction, but is

always a tremulous, and, often, a blighting one. These phenomena are very unwelcome to the lover of nature, and are nowhere described by poets or transcribed by painters. Mr. Ruskin suggests that they are smoke clouds, and the lectures may be regarded as a contribution to the subject of modern sunset phenomena. Indeed, included in the lectures and notes are several valuable direct contributions to this topic.

That there is latterly an increase in persistent cloudiness no regular observer of the heavens can doubt, and the recent cloudiness does seem to take on something of the character described by Mr. Ruskin. The writer has observed it in the Central States since 1879. H.

(240) **Assmann.** *Wendelstein und Säntis, die beiden meteoro'ogischen Hochstàtionen Bayerns und der Schweitz.* The station Wendelstein is in Bavaria and its altitude above sea level is more than 1800 metres. Säntis is in Switzerland and at an altitude of about 2500 metres. Both stations are supplied with the usual meteorological instruments and also various self recording ones. The paper is mostly taken up with a description of the buildings and their contents, from a personal inspection of the stations by Dr. Assman. S.

(241) **Leonhard Sohncke.** "*Der Ursprung der Gewitter elektricität* etc." Jena 1885. This is a recent pamphlet of 74 pages, on the origin of lightning and other forms of atmospheric electricity. Two factors, the author thinks that as yet have received but little attention, will, if closely studied throw much light on the occurrence of thunder storms. These are, first, the average temperature condition of the free air, at elevated regions and secondly, the character of the cloud masses. The temperature variation seems to bear a close relation to the frequency of thunder storms. The results of Glaisher's ascents, together with those of eight ascents made by the author, are given to support this belief. For example, on a certain date, when a thunder storm occurred, Glaisher found the temperature to average, at an elevation of about 2300 metres, 1° C. All the other ascents, on days free from storms, show this temperature at a much higher elevation. Comparisons of the temperature variations at Frieburg in Breisgau and an exposed station, 719 metres higher, show that in only three cases out of seventeen, is there a temperature difference as small as that preceding a thunder-storm, while the daily and yearly averages were in all cases greater. Dr. Sohncke has much to say, on the study of the cloud masses, as a means of further knowledge of the formation of sleet, hail, and ice crystals. A. M.

(242) **J. Hann.** *Die Temperatur Verhältnisse der österreichischen Alpenländer.* II and III Theil. Sitze. Akad. Wiss. Wien. xci, xcii, 1885. 51 and 166 pages. The first part of this memoir was noticed in the June number of the *Journal:* the second and third parts have now appeared and complete the work. It is throughout a careful and discriminating study of a rich mass of material: it will be long before a similar monograph can

be made in this country. The second paper opens with a comparison of records in and near Vienna to determine how far local influences may affect results. In Vienna, three stations with records for 1851–70, 1852–70 and 1878–84 give when reduced to the normal period, 1851–1880, mean annual temperatures of 9°.71, 9.69, 9.67 centigrade; a remarkable agreement, considering the difference in the position and exposure of the thermometers. Comparisons of the city with the wooded country near by show the smallest differences at the warmest hours, and the greatest in the evening; but the means show no irregular differences. It is therefore concluded that with ordinary care to protect the thermometer from immediate local disturbing influences, the mean annual and monthly temperatures can be determined within one or two tenths of a centigrade degree: the necessity of careful determination and application of thermometer corrections is thus emphasized. Injurious local influences are next examined, and with them the changes produced by alteration in the surroundings of the thermometer or by its removal, whereby the observations lose their "homogeneous" character, and the station loses its historical value. It appears very clearly from the results here gained that one must be very cautious in making deductions concerning climatic changes in brief periods, the changes are probably in the exposure of the thermometers.

The third part of the work gives the final values for annual and monthly temperatures, reduced to the true 24-hour mean and to the 1851–80 periods for 382 stations. There is on the average one station to every 6.6 German square miles. Forty-two stations are above 1500 metres elevation; seventeen above 2000 m. The observations are for more than ten years at 129 places; for more than twenty years at fifty-three places. The whole number of years of observation is 2414. About 30,000 corrections were applied; commenting on this, the author says: "this tiresome occupation was lightened by the personal interest which held me to the work. Most of the stations were almost like dear friends and brought me pleasant memories of beautiful summer days enjoyed with them. The work was like a tribute of thanks. I felt and still feel a lively satisfaction in being able to add something by my fatiguing work to the investigation of those places which had so often been to me a source of recreation and exalted impressions."

The general statements, of interest even at this distance from the Alps, are too numerous to present here. In the mountains, the valleys have a more variable year than the peaks of the same elevation. The decrease of temperature with height is given with great detail, and concise tables present the altitude and change of altitude of the monthly isotherm of 0° C. in different districts. *Increase* of temperature with altitude appears in part of the Alpine region even in the 30-year means; so it is not merely an occasional occurrence but a regular climatic element. W. M. D.

(243) **Mariano Bárcena y Miguel Perez.** *Estudios de Meteorologia comparada*, Ministerio de Fomento de la República Mexicana, Observatorio meteorológico-magnético central de México. Vol. I. Mexico, 1885. Public Document, octavo, pp. 437.—Our worthy colleagues in Mexico, among whom the two whose names stand above are pre-eminent, are laboring industriously and skillfully on the problems presented by the climate and geography of Mexico. In this volume we have the first installment of the study. It is a discussion of the observations over Mexico monthly for the first four months of 1881. Aside from the City of Mexico, the observations are from fifteen or twenty stations scattered over the republic, all but one (Guaymas) being south of latitude 25°. This contribution is to be looked on as a thesaurus from which each reader must draw his own conclusions. We regret that the authors have not drawn some general conclusions for us. They were best able to do it, and it would save the reader much labor. The work covers only part of a year; it is to be hoped that they will do this when the year is completed. Meantime we have in this volume the means of drawing some conclusions concerning the climate of Mexico, a means which has been almost entirely lacking since the time of Humboldt. H.

(244) **Department of Agriculture.** *Report of the Statistician.* Report on the Crops of the Year, and on Freight Rates of Transportation Companies. Monthly. Washington, 1885.—This thick pamphlet is of decided value. The number for December contains 54 pages, and in them is much of meteorological interest. The tables of latest and earliest frosts (pp. 20–23) are of value, and there is much of a suggestive character scattered through the entire publication. This is from the standpoint of this JOURNAL. For the farmer and shipper the publication is, of course, of the highest value. H.

(246) **H. Allen Hazen.** *Condensing Hygrometer and Psychrometer.* From the December number (1885) of the *American Journal of Science*, Vol. XXX, pp. 432–448.—This is a valuable addition to our literature on a class of instruments which need farther ventilation. (No pun intended.) Professor Hazen handles the subject frankly, but is more hopeful than most students. The sources of error involved are carefully studied, and a table of relative humidities, adapted to the sling-psychrometer especially, is added. H.

(245) **Weather Reports.**—*Alabama:* Published in the printing office of the Agricultural and Mechanical College by special order of the Board of Trustees, Auburn. Nov., 8 pp. octavo. Contains reports of the tornado of Nov. 6. Dec., 8 pp., octavo. Reports from thirty-five observers.—*Blue Hill Meteorological Observatory.* A. Lawrence Rotch, proprietor, Willard P. Gerrish, observer. Readville, Mass., January. Rain signals gave a verification of 66%, cold wave signals, 50%.—*Central Park*: New York Meteorological Observatory of the Department of Public Works,

Daniel Draper, Ph. D., director. Abstract of registers from self-recording instruments.—*Canada:* Meteorological Service Dominion of Canada, Charles Carpmael, superintendent, Toronto. Monthly Weather Review, 4to, Nov. 8 pp., Dec. 10 pp., with diagrams of wind-frequency. Accompanying the Dec. No. is an eight page octavo pamphlet of Toronto Meteorological Register for 1885. 1885 was the coldest year on the records, except 1875, when the mean temperature was 0.8° lower. In 1885 it was 41.57°.—*Carson City, Nevada:* Summary of observations made at Carson Observatory: Chas. W. Friend, observer; October, November, January. An unusually heavy rainfall flooded the streets of the city on January 23.—*Indiana:* Meteorological summary from stations of the Indiana Weather Service, compiled at De Pauw University, Greencastle, Ind., under direction of Prof. W. H. Ragan; September, October, November and December.—*Iowa:* Iowa Weather Bulletin, Gustavus Henrichs, director, Iowa City; November and December.—*Lansing:* Weekly Meteorological Report, from the secretary of the State Board of Health.—*Montreal:* Meteorological Observations, McGill College Observatory, C. H. McLeod, superintendent; October, November, December and January.—*Michigan:* Crop Report, prepared and published by the Secretary of State, Lansing; 8 pp., octavo; December and January.—Weekly Report of Health in Michigan, by Henry B. Baker, Secretary of the State Board of Health.—*Minnesota:* Weather Service, central office, Carleton College, Northfield; W. W. Payne, director; D. R. McGinnis, Sig. Corps, U. S. A., in charge: octavo, Nov. (4 pp.), Dec. (6 pp.), Jan. (4 pp., 19 observers).—*Missouri:* Weather Service, Francis E. Nipher, director, Washington University, St. Louis; octavo, 4 pp., and rainfall map; Nov., Dec., Jan., 37 stations.—*Nashville:* Signal Service Weekly Rainfall Reports, L. N. Jesunofsky, Sergeant Sig. Corps, U. S. A.—*Nebraska:* Weather Service Bulletin, Boswell Observatory, Doane College, Crete, Goodwin D. Swezey, director; November, January and Annual Report.—*New England:* Bulletin of the New England Meteorological Society, Winslow Upton, President, Providence, R. I.; octavo, 8 pp.; Nov. and Dec., 136 observers. Each bulletin has a map on which is entered the precipitation and range in temperature.—*Ohio:* Report of the Ohio Meteorological Bureau; Board of Directors, Benjamin F. Thomas, President, W. I. Chamberlain, and Geo. H. Twiss, Secretary, E. H. Mark; Columbus; octavo, 52–60 pp., October, November and December.—*St. Lawrence, Dakota:* The St. Lawrence *Tribune* publishes weekly reports both for St. Lawrence and Huron.—*Tennessee:* State Board of Health Bulletin, J. D. Plunkett, M. D., President, J. Berrien Lindsley, M. D., Secretary, Nashville; octavo, 16 pp.; October, November and December. Also a supplement for October, entitled "A Report on the Climatic Influence of the Tennessee Mountain Region on Health and Disease," by Daniel F. Wright, M. D., chairman of committee; 16 pp.. It will be noticed elsewhere.

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